

Application No.: 10/091,942

Docket No.: JCLA8556

REMARKSPresent Status of the Application

The drawings are objected to. The Office Action rejected claims 1-6, 8, and 9 under 35 U.S.C. 103(a), as being unpatentable over the Applicant's Prior Art Figure 6 (APAF) in view of Lebowitz (U.S. 4,694,561, hereafter Lebowitz). Further, the Office Action objected to claims 6 and 7 as being dependent upon a rejected base claim, but would be allowable if rewritten in independent from including all of the limitation of the base claim and intervening claims. The Office Action allowed claims 10-13. Applicants have amended Fig. 6 to overcome the objection and have added claims 14-16 to more fully protect the invention. No new matter has been added to the application by the amendments made to the claims or otherwise in the application. After entry of the foregoing amendments, claims 1-16 remain pending in the present application, and reconsideration of those claims is respectfully requested.

Discussion of Objections

The drawings were objected to under MPEP 608.02(g) because Fig. 6 does not show a legend such as -Prior Art-. In response thereto, applicants have added the legend "Prior Art" to Fig. 6. Reconsideration and withdrawal of the Examiner's objection is respectfully requested.

Discussion of Office Action Rejections

Claims 1-6, 8, and 9 are rejected under 35 U.S.C. 103(a), as being unpatentable over the Applicant's Prior Art Figure 6 (APAF) in view of Lebowitz (U.S. 4,694,561).

Applicants respectfully traverse the rejections for at least the reasons set forth below.

The present invention is directed to variable capacitor structures. Since the quality factor (Q) of the variable capacitor is inversely proportional to its resistance and capacitance and the capacitance value is the required capacitance of this variable capacitor, the quality factor of the variable capacitor can be improved only by lowering the resistance of the variable capacitor. However, in a conventional variable capacitor structure, the resistance of the variable capacitor is largely affected by the high resistance of the N-well. Accordingly, one object of the present invention is to provide a variable capacitor or varactor having a considerably *smaller resistance*.

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The overall resistance of the variable capacitor structures is decreased since the thickness from the P⁺-doped region to N⁺ buried layer is reduced by forming a cavity on N-well and forming the P⁺-doped region at the bottom of the cavity.

The features are recited in claim 1.

Independent claim 1 recites the features as follows:

1. A variable capacitor structure, comprising:
 - a substrate;
 - a first type ion-doped well within the substrate, wherein the first type ion-doped well has a cavity;*
 - a first-type ion-doped buried layer in the substrate underneath the first type ion-doped well, wherein the first type ion-doped buried layer and the first type ion-doped well are connected;
 - a second type ion-doped region at the bottom of the cavity* of the first type ion-doped well; and
 - a conductive layer over the first type ion-doped buried layer, wherein the conductive layer and the first type ion-doped buried layer are connected.

The Office Action acknowledged that the APAF does not teach the first type ion-doped well having a cavity, but relied on Lebowitz to supply the missing elements. Lebowitz does not teach forming trenches in a substrate to increase capacitance. However, Lebowitz never teaches to form a trench or cavity in a first type ion-doped well and form a second type ion-doped region at the bottom of the cavity for the purpose of reducing resistance.

Lebowitz's invention is a trench version of a high-capacitance capacitor for a dynamic random-access-memory cell. In order to increase capacitance, a shallow trench is formed in the substrate. The capacitor for the dynamic random-access-memory cell is different from the variable capacitor. Conspicuously, *the field* of Lebowitz is different from that of the Applicant's Prior Art. Furthermore, *the object* of Lebowitz is in increasing capacitance, rather than reducing resistance of the present invention. In addition, Lebowitz fails to teach or suggest the resistance of the variable capacitor can be reduced by forming a cavity on N-well. There is no motivation or suggestion to combine the Applicant's Prior Art Figure 6 (APAF) and Lebowitz as proposed. Applicants therefore respectfully submit that APAF in view of Lebowitz cannot render the present invention as defined in claim 1 obvious. Applicants respectfully request that the rejection to claim 1 be withdrawn.

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For at least the foregoing reasons, Applicant respectfully submits that independent claims 1 patentably define over the prior art references, and should be allowed. For at least the same reasons, dependent claims 2-5 and 8-9 patentably define over the prior art as well. Accordingly, Applicants request that the Section 103 (a) rejection to claims 1-5, 8 and 9 and the objection to claim 6 and 7 be withdrawn.

The Examiner is thanked for indicating that claims 6 and 7 contain patentable subject matter and for allowing claims 10-13.

New claims 14-16

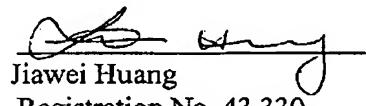
Claims 14-16 are added to more fully protect the present invention. Claims 14-16 indirectly depend from claim 1 and are believed patentable.

CONCLUSION

For at least the foregoing reasons, it is believed that the pending claims 1-16 are in proper condition for allowance. If the Examiner believes that a telephone conference would expedite the examination of the above-identified patent application, the Examiner is invited to call the undersigned.

Respectfully submitted,
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